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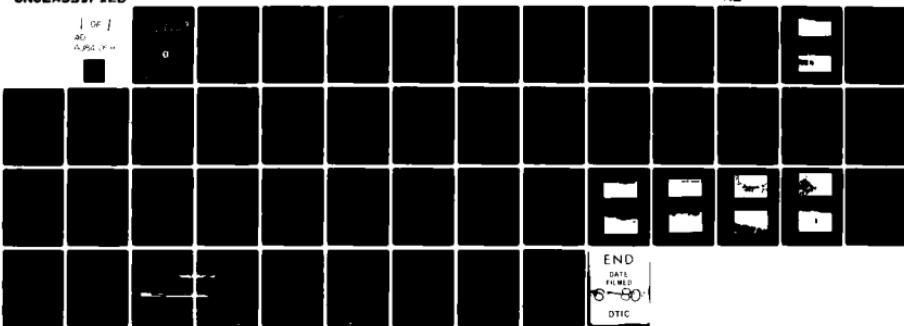
O'BRIEN AND GERE ENGINEERS INC PHILADELPHIA PA JUSTIN--ETC F/G 13/13
NATIONAL DAM SAFETY PROGRAM, EDGEMOOR RESERVOIR (DE00012). DELA--ETC(U)
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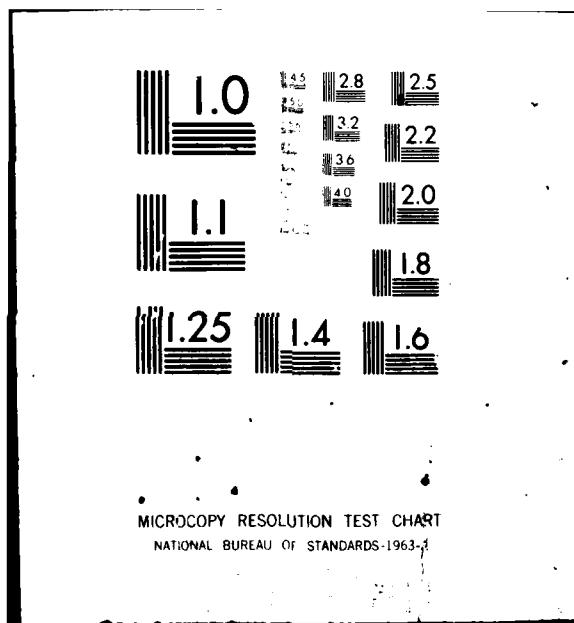
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DELAWARE RIVER BASIN
SHELLPOT CREEK OFFSTREAM
NEW CASTLE COUNTY

DELAWARE

LEVEL II
EDGEMOOR RESERVOIR

DTIC
SELECTED
MAY 8 1980

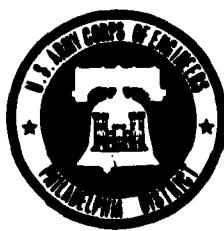
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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



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DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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December, 1979

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1. REPORT NUMBER DE00012	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Edgemoor Reservoir New Castle County, Del.		5. TYPE OF REPORT & PERIOD COVERED FINAL
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams Visual inspection Embankments National Dam Inspection Act report Structural analysis Edgemoor Reservoir, Del. Safety		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

17 APR 1980

Honorable Pierre S. DuPont
Governor of Delaware
Dover, Delaware 19901

Dear Governor DuPont:

Inclosed is the Phase I Inspection Report for Edgemoor Reservoir in New Castle County, Delaware which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Edgemoor Reservoir, a high hazard potential structure, is judged to be in good overall condition. However, the capacity of the reservoir is not adequate to contain the selected design storm of one-half of the Probable Maximum Precipitation. To insure adequacy of the structure, the following actions, as a minimum, are recommended to be undertaken within six months from the date of this report:

a. The reservoir surface should be maintained at or below Elevation 82.0 to allow adequate surcharge storage for the design storm.

b. Consideration should be given to the installation of an audible high stage warning system to alert operating personnel of extreme high reservoir elevations.

c. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.

d. The bushes and trees growing on the interior slope of the embankment should be removed. Gaps and spaces left in the masonry joints by the removal of the vegetation should be sealed.

e. The portion of the crest and interior slope which was damaged during the construction of the telemeter should be repaired.

NAPEN-N

Honorable Pierre S. DuPont

f. The broken pipe located along the interior slope near the northern end of the reservoir should be removed. The hole left in the embankment by the removal of the pipe should be filled with compacted earth.

g. A regular maintenance program should be established which would include, but not be limited to, removal of brush from the interior and exterior slopes and repair of the masonry lining on the interior slope as required.

A copy of the report is being furnished to Mr. James Wilson III, Delaware Department of Natural Resources and Environmental Control, the designated State Office contact for this Program. Within five days of the date of this letter, a copy will also be sent to Congressman Thomas B. Evans. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, thirty days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



JAMES G. TON
Colonel, Corps of Engineers
District Engineer
Division For

Mr. James Wilson III	Check
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As stated

Copies Furnished:

Mr. James Wilson III, Acting Secretary
Department of Natural Resources and
Environmental Control
Edward Tatnall Bldg.
Dover, DE 19901

Mr. William R. Ratledge, Director
Division of Soil & Water Conservation
DDNR & EC
Dover, DE 19901

EDGEMOOR RESERVOIR (DE00012)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 20 September and 11 October 1979 by O'Brien and Gere Engineers, Inc., under contract to the U.S. Army Engineer District, Philadelphia in accordance with the National Dam Inspection Act, Public Law 92-367.

Edgemoor Reservoir, a high hazard potential structure, is judged to be in good overall condition. However, the capacity of the reservoir is not adequate to contain the selected design storm of one-half of the Probable Maximum Precipitation. To insure adequacy of the structure, the following actions, as a minimum, are recommended to be undertaken within six months from the date of this report:

- a. The reservoir surface should be maintained at or below Elevation 82.0 to allow adequate surcharge storage for the design storm.
- b. Consideration should be given to the installation of an audible high stage warning system to alert operating personnel of extreme high reservoir elevations.
- c. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.
- d. The bushes and trees growing on the interior slope of the embankment should be removed. Gaps and spaces left in the masonry joints by the removal of the vegetation should be sealed.
- e. The portion of the crest and interior slope which was damaged during the construction of the telemeter should be repaired.
- f. The broken pipe located along the interior slope near the northern end of the reservoir should be removed. The hole left in the embankment by the removal of the pipe should be filled with compacted earth.
- g. A regular maintenance program should be established which would include, but not be limited to, removal of brush from the interior and exterior slopes and repair of the masonry lining on the interior slope as required.

APPROVED:


JAMES G. TON

Colonel, Corps of Engineers
District Engineer

DATE:

17 November 1980

DELAWARE RIVER BASIN

⑨ Final rep't

⑩ John J. Latellian

Name of Dam: Edgemoor Reservoir Dam
County & State: New Castle County, Delaware
Inventory Number: DE 00012

⑪ Dec 79

⑫ DDCW 61-78-C-0052

⑬ PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Edgemoor Reservoir (DE 00012).
Delaware River Basin. Shellfoot
Creek offstream, New Castle
County, Delaware.

⑭ Phase I Inspection Report

Prepared by:

O'BRIEN & GERE ENGINEERS, INC.
JUSTIN & COURTNEY DIVISION

⑮ 49

For

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Custom House-2nd & Chestnut Streets
Philadelphia, PA 19106

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM •

Name of Dam: Edgemoor Reservoir Dam ~~ED~~(DE 00012)
State Located: Delaware
County Located: New Castle
Stream: Offstream Shellpot Creek
Coordinates: Latitude 39° 45.4', Longitude 75° 31.3'
Dates of Inspection: September 20, 1979 and October 11, 1979

ASSESSMENT

Based on visual observations made during the dates of the inspection, information provided by the Delaware Department of Natural Resources and Environmental Control (DNREC), and conversations with the Owner's representative, Edgemoor Reservoir Dam (owned by the Wilmington Suburban Water Company) is considered to be in overall good condition.

Edgemoor Reservoir is an offstream impoundment located approximately 1,000 feet west of Shellpot Creek and 300 feet east of the corporate boundary of the City of Wilmington, Delaware. The dam is a homogeneous earth embankment aligned in a circular configuration in plan so that the dam completely encloses the reservoir. The circular length of the embankment is approximately 1,760 feet and the maximum height is about 17 feet. The interior slope of the embankment is lined with concrete and stone masonry. The reservoir functions as a water supply impoundment for the Wilmington Suburban area.

The selected design storm for this Small size, High hazard dam is 50 percent of the Probable Maximum Precipitation (PMP). The reservoir is capable of retaining approximately 88 percent of the design storm without overtopping of the embankment. The initial reservoir level was taken as Elevation 82.3, which is shown as the flow line elevation on Figure 3 (one foot below the top of dam). The design storm would overtop the embankment by approximately 1.7 inches. Therefore, the flood storage capacity of the reservoir is inadequate for retaining the design storm.

Recommendations and remedial measures which should be initiated in the near future are as follows:

a. Facilities

1. The vegetation growing on the interior slope of the embankment should be removed. Gaps and spaces left in the masonry joints by the removal of the vegetation should be sealed.

2. The portion of the crest and interior slope which was damaged during the construction of the telemeter system should be repaired.

3. The broken pipe located along the interior slope near the northern end of the reservoir should be removed. The hole left in the embankment by the removal of the pipe should be filled with compacted earth.

b. Operation and Maintenance Procedures

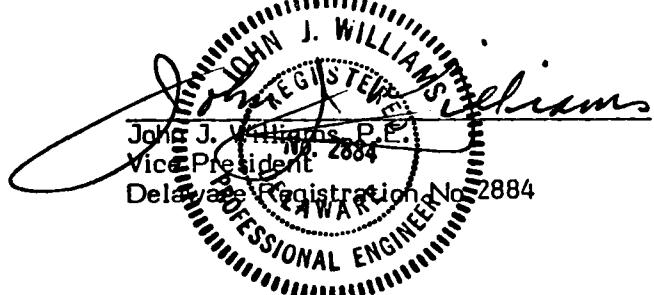
1. A regular maintenance program should be established which would include, but not be limited to, removal of brush from the interior and exterior slopes and repair of the masonry lining on the interior slope as required.

2. The reservoir surface should be maintained at or below Elevation 82.0 to allow adequate surcharge storage for the design storm.

3. Consideration should be given to the installation of an audible high stage warning system to alert operating personnel of extreme high reservoir elevations.

4. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.

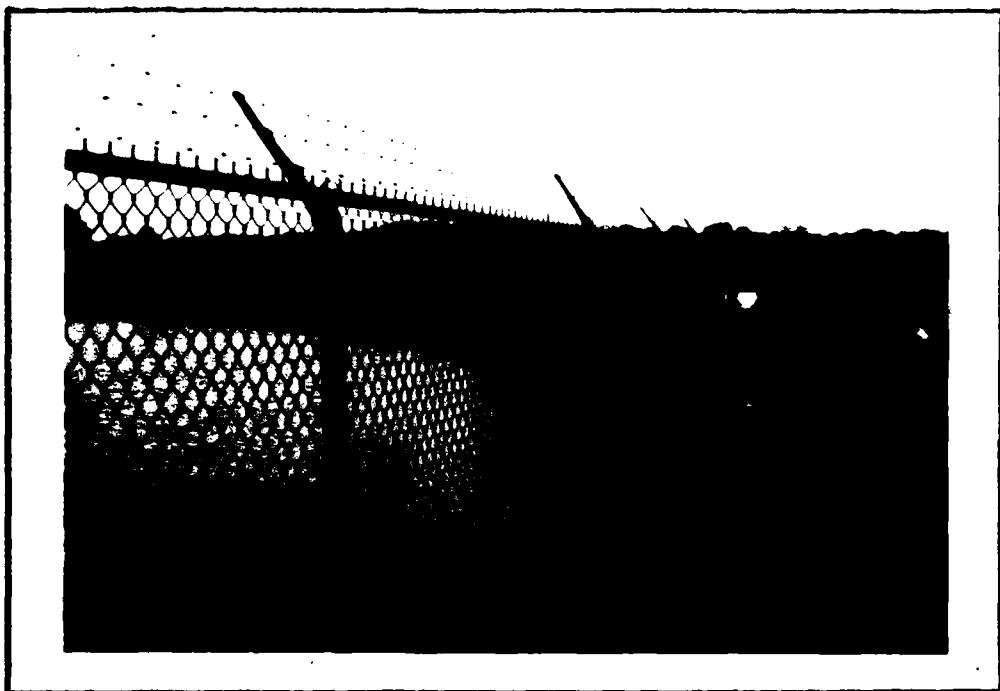
O'BRIEN & GERE ENGINEERS, INC.



Date: 8 Feb 1980



EXTERIOR OF NORTHERN PORTION
OF EMBANKMENT 10-11-79



SOUTHWESTERN PORTION OF CREST
AND INTERIOR OF EMBANKMENT 10-11-79

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
EDGEMOOR RESERVOIR DAM
INVENTORY NUMBER - DE 00012

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with contract # DACW 61-78-C-0052 between O'Brien & Gere Engineers, Justin & Courtney Division and the United States Army Corps of Engineers, Philadelphia District.

b. Purpose of Inspection. The purpose of this inspection is to evaluate the structural and hydraulic condition of Edgemoor Reservoir Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 Project Description (Based on information obtained from the Delaware Department of Natural Resources and Environmental Control (DNREC) Dover, Delaware).

a. Description of Dam and Appurtenances. Edgemoor Reservoir Dam is a homogeneous earth embankment aligned in a circular configuration in plan so that the dam completely encloses the reservoir (refer to Plate 2 in Appendix E). The circular length of the embankment is approximately 1,760 feet and the maximum height is about 17 feet. The side slopes are 1.5 horizontal and 1 vertical (1.5H:1V) and the crest of the dam is 11 feet wide.

The interior slope is protected by a 12-inch thick layer of concrete from the toe of the dam to Elev. 77.3 and by an 18-inch thick layer of stone masonry from Elev. 77.3 to Elev. 80.3. The slope protection for the original embankment terminated at Elev. 80.3 and the top of the dam was at Elev. 82.3. However, in 1942, the storage capacity of the reservoir was increased by raising the top of the embankment to Elev. 83.3 and increasing the normal pool level from Elev. 79.3 to Elev. 82.3. The interior slope protection was extended to Elev. 81.6 by means of a 12-inch thick layer of stone masonry, then to the crest of the dam with a 12-inch thick, vertical, stone masonry wall (refer to Plate 3 in Appendix E). The original crest of the dam was graded to the top of the wall with compacted fill on an approximate slope of 7H:1V.

The reservoir has a maximum pool diameter of 559.6 feet. The floor of the reservoir is surfaced with a 3-inch thick layer of concrete which is underlain by a 16-inch thick layer of puddle or compacted material. The reservoir floor is

excavated into natural ground so that the exterior ground surface is several feet above the reservoir floor.

There is no spillway provided for this structure. A 16-inch diameter pipe is provided as an outlet for water supply and reservoir drawdown. Water is also pumped into the reservoir from Stanton Reservoir through this pipe during periods of low demand.

b. Location. Edgemoor Reservoir is an offstream impoundment located approximately 1,000 feet west of Shellpot Creek and 300 feet east of the corporate boundary of the City of Wilmington, Delaware. The reservoir is shown on the USGS Quadrangle entitled, "Wilmington North, Delaware-Pennsylvania" at coordinates N $39^{\circ} 45.4'$, W $75^{\circ} 31.3'$. A regional location map of Edgemoor Reservoir is included as Plate 1 in Appendix E.

c. Size Classification. Edgemoor Reservoir Dam has a maximum height of about 17 feet and a maximum storage capacity of approximately 82 acre-feet. The dam is classified in the Small size category since it is less than 40 feet high with a storage capacity of less than 1,000 acre-feet.

d. Hazard Classification. There are several buildings between Edgemoor Reservoir and Shellpot Creek. A failure of the embankment could cause floodwaters to be directed toward Shellpot Creek, resulting in extensive property damage and probable loss of life. Therefore, the dam is classified in the High hazard category.

e. Ownership. Edgemoor Reservoir Dam is owned by the Wilmington Suburban Water Company, 3219 Philadelphia Pike, Claymont, Delaware, 19703.

f. Purpose of Dam. The dam was originally constructed to impound a water supply for the Pennsylvania Railroad. The reservoir currently supplies water for the Wilmington Suburban area.

g. Design and Construction History. The dam appears to have been designed in 1905 by the original owner, the Pennsylvania Railroad, and constructed shortly thereafter. The storage capacity was increased by raising the top of the dam in 1942. This work was apparently performed by the Pennsylvania Railroad. The Wilmington Suburban Water Company purchased the dam and reservoir in 1956.

h. Normal Operating Procedures. According to Mr. Pete Sheats, the Purification Superintendent for the Wilmington Suburban Water Company, the reservoir water supply fluctuates, dependent upon the water demand. Water is pumped into the reservoir during periods of low demand and withdrawn from the reservoir to the water supply system during periods of high demand.

1.3 Pertinent Data (Based on information obtained from DNREC).

a. Drainage Area. The drainage area to Edgemoor Reservoir is identical to the maximum pool surface area. The drainage area is 5.6 acres.

b. Discharge at Dam Site. No spillway is provided for this dam. Discharge capabilities are restricted to the drawdown and water supply pipes. A 16-inch diameter pipe provides the only outlet for the reservoir.

c. Elevation (feet above MSL).

Normal Pool (from 1942 drawing)	82.3
Maximum Pool of Record	82.3
Top of Dam	83.3
Minimum Reservoir Floor	66.3
Maximum Reservoir Floor	68.3

d. Reservoir Length (feet).

Normal Pool	560
Maximum Pool	560

e. Storage (acre-feet).

Normal Pool	76.5
Maximum Pool	82.1

f. Reservoir Surface Area (acres).

Normal Pool	5.6
Maximum Pool	5.6

g. Dam.

Type	Earth
Length	1,760 feet
Height	17 feet
Crest Width	11 feet
Side Slopes	1.5H:1V (interior) 1.5H:1V (exterior)
Zoning	None
Impervious Core	None
Cutoff	None
Grout Curtain	None

h. Spillway.

None

i. Outlet Works.

Type	16-inch diameter pipe
Closure	16-inch sluice gate approximately 20 feet from the toe of the exterior slope.
Access	The gate is located beneath a metal plate in the ground.
Regulating Facilities	The sluice gate may be operated by a hand wheel.

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. The engineering data made available by the Delaware DNREC consisted of the following two drawings:

1. Edgemoor Reservoir Plan and Cross-sections (1905).
2. Edgemoor Reservoir Proposed Increase in Capacity (1942).

These drawings appear as Figures 2 and 3 in Appendix E of this report.

b. Design Features. The principal design features for this structure are shown on the drawings in Appendix E and are described in Section 1.2.a of this report.

2.2 Construction

Edgemoor Reservoir Dam appears to have been originally constructed about 1905. The storage capacity appears to have been increased by raising the crest of the dam around 1942. No information relative to the actual construction of the dam is available.

2.3 Operation

According to the Owner's Representative, a telemetric water level reader continuously records the reservoir surface elevation and the data is monitored 24 hours a day.

2.4 Evaluation

- a. Availability. The limited information available was provided by DNREC.
- b. Adequacy. The information made available by DNREC, conversations with the Owner's representative and observations made during the field investigation provided adequate data for a Phase I evaluation.
- c. Validity. There appears to be no reason to question the validity of the data obtained from DNREC.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. Field inspections of Edgemoor Reservoir Dam took place on September 20, 1979 and October 11, 1979. At the time of the inspections, the reservoir water surface was approximately 4 feet below the crest of the dam. No underwater areas were inspected. The observations and comments of the field inspection team are in the checklist which is Appendix B of this report. The appearance of the facility indicates that the dam and its appurtenances are marginally maintained.

b. Dam. On the date of the initial inspection, the exterior slope was concealed by a thick cover of vegetation. After the initial inspection, the vegetation on the exterior slope was cleared and a second inspection was performed. The crest and exterior slope of the embankment appear to be in good condition. There are no signs of seepage or slope instability along the length of the embankment.

On the date of the inspection, trees and bushes were observed growing from the masonry joints on the interior slope of the embankment above the reservoir surface. The roots of these trees and bushes have created gaps and spaces in the masonry joints.

A portion of the crest and interior slope toward the southern part of the embankment is in a state of disrepair. According to Mr. Sheats, the Owner's Representative, this damage occurred during the installation of the telemetric device.

Several saturated areas were observed near the exterior toe of the embankment during the inspection. However, these areas appeared to be a result of surface runoff rather than seepage through the embankment.

c. Appurtenant Structures. The 16-inch diameter pipe, through which all inflows and outflows occur, is located through the base of the embankment and could not be inspected. A broken pipe extends above the reservoir surface along the interior slope near the northern end of the reservoir. This pipe creates a potential seepage path through the embankment. According to the Owner's Representative, this pipe supplied water to a nearby shop which is no longer occupied.

d. Reservoir Area. The concrete surfaces of the reservoir bottom and the interior slope below Elev. 77.3, and the stone masonry of the interior slope between Elevations 77.2 and 79.3, were submerged at the time of the inspection. Therefore, their condition could not be determined. The stone masonry slope above the reservoir surface appears to be in good condition, except for the gaps caused by the growth of vegetation.

e. Downstream Channel. Discharge from the reservoir takes place through the 16-inch diameter water supply pipe. Shellpot Creek, the nearest stream, is approximately 1,000 feet to the east of Edgemoor Reservoir Dam.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedures

According to the Owner's representative, the reservoir water surface elevation fluctuates in response to the water demand. During periods of low demand, water is pumped into Edgemoor Reservoir from Stanton Reservoir by means of a 16-inch diameter pipe. During periods of high demand, water is withdrawn from Edgemoor Reservoir to the water supply system through the same 16-inch diameter pipe.

4.2 Maintenance of Dam

No maintenance program has been established for Edgemoor Reservoir Dam. The exterior slope of the embankment had been cut prior to the second inspection. However, prior to this year, the embankment had not been maintained for a long period of time.

4.3 Maintenance of Operating Facilities

According to the Owner's representative, the water supply and drawdown gates are operated periodically.

4.4 Description of Warning Systems in Effect

No official flood warning systems are in effect at this site.

4.5 Evaluation of Operational Adequacy

A regular maintenance program should be established which would include, but not be limited to, removal of brush from the interior and exterior slopes and repair of the masonry lining on the interior slope as required.

Consideration should be given to the installation of an audible high stage warning system to alert operating personnel of extreme high reservoir elevations.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Edgemoor Reservoir has a maximum pool surface area of about 5.6 acres, a maximum storage capacity of about 82 acre-feet, and a drainage area equal to the maximum reservoir surface area. There is no spillway provided for this structure.

Emergency drawdown of the reservoir can be accomplished by discharging through the 16-inch diameter water supply pipe.

b. Experience Data. According to the Owner's representative, the reservoir water level is measured and recorded continuously by a telemetric device. The telemeter is monitored 24 hours a day. The maximum pool elevation recorded in the last 20 years is approximately one foot below the crest of the dam (Elev. 82.3). The Owner's representative stated that the water supply system is capable of drawing approximately 8 million gallons a day (mgd) from the reservoir. Therefore, the reservoir could be completely drawn down in about 3 days.

c. Visual Observations. The 16-inch diameter pipe provides the only outlet from the reservoir. The pipe could not be inspected and it could not be determined if the pipe is susceptible to blockage.

d. Overtopping Potential. Edgemoor Reservoir Dam has no spillway and is isolated from surface runoff. Therefore, a design storm was selected for analysis rather than a Spillway Design Flood. The recommended design storm for a Small size, High hazard dam ranges from 50 percent of the Probable Maximum Precipitation (PMP) to the full PMP. Due to the limited storage capacity and wide flood area, the selected design storm was 50 percent of the PMP.

Neglecting reservoir drawdown capabilities, Edgemoor Reservoir Dam can retain approximately 88% of the design storm with the initial reservoir surface Elevation at 82.3 prior to overtopping of the embankment.

e. Drain System Adequacy. The design storm (50 percent of the PMP) would overtop the embankment by approximately 1.7 inches. Therefore, the flood storage capacity of the reservoir is inadequate for retaining the design storm. Based on a drawdown capability of 8 mgd, the reservoir could be drawn down 1.7 inches from maximum pool in less than an hour (refer to Appendix C for computations).

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. There is no evidence of slope instability or excessive settlement of the embankment. The vegetation growing from the interior slope could create seepage paths through the embankment. Continued growth of this vegetation could lead to deterioration of the embankment.

b. Design and Construction Data. Edgemoor Reservoir Dam appears to have been constructed in general conformance with the available design drawings. The drawings do not indicate the composition of the embankment material.

c. Operating Records. Records of operation are maintained at the treatment plant which is located approximately 200 feet east of the dam.

d. Post Construction Changes. The top of the dam was raised from Elevation 82.3 to Elevation 83.3 about 1942 to increase the storage capacity of the reservoir. This was accomplished by extending the stone masonry one foot vertically above the existing crest and grading the crest up to the top of the masonry wall.

e. Seismic Stability. Edgemoor Reservoir Dam is located in Seismic Zone 1 on the "Seismic Zone Map of Contiguous States." A dam located in Seismic Zone 1 is generally considered to be safe under expected earthquake loadings in this zone if it is stable under static loading conditions. Based on the field inspection, Edgemoor Reservoir Dam appears to be stable for static conditions.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual observations and review of available information indicate that Edgemoor Reservoir Dam is in good condition.

The selected design storm for this dam is 50 percent of the PMP. The reservoir is capable of retaining approximately 44 percent of the PMP prior to overtopping of the embankment. The design storm would overtop the embankment by approximately 1.7 inches. Therefore, the flood storage capacity of the reservoir is inadequate for retaining the design storm.

b. Adequacy of Information. The information provided by DNREC, conversations with the Owner's Representative, and observations made during the field investigation provided adequate data for a Phase I investigation.

c. Urgency. The remedial measures recommended in Section 7.2 should be implemented in the near future.

d. Necessity for Further Investigation. No further investigations are considered necessary at this time.

7.2 Recommendations and Proposed Remedial Measures

a. Facilities

1. The bushes and trees growing from the interior slope of the embankment should be removed. Gaps and spaces left in the masonry joints by the removal of the vegetation should be sealed.

2. The portion of the crest and interior slope which was damaged during the construction of the telemeter should be repaired.

3. The broken pipe located along the interior slope near the northern end of the reservoir should be removed. The hole left in the embankment by the removal of the pipe should be filled with compacted earth.

b. Operation and Maintenance Procedures

1. A regular maintenance program should be established which would include, but not be limited to, removal of brush from the interior and exterior slopes and repair of the masonry lining on the interior slope as required.

2. The reservoir surface should be maintained at or below Elevation 82.0 to allow adequate surcharge storage for the design storm.

3. Consideration should be given to the installation of an audible high stage warning system to alert operating personnel of extreme high reservoir elevations.

4. An emergency action plan should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency. This plan should include an effective warning system.

APPENDIX

A

Check List Engineering Data
Design, Construction, Operation
Phase I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Edgemoor Reservoir Dam

ID # DE 00012

Sheet 1 of 4

REMARKS

AS-BUILT DRAWINGS None Available.

REGIONAL VICINITY MAP Refer to Figure 1 in Appendix E.

CONSTRUCTION HISTORY There is no construction history information available.

TYPICAL SECTIONS OF DAM Refer to Figures 2 and 3 in Appendix E.

OUTLETS - PLAIN } None Available
DETAILS }
CONSTRAINTS
DISCHARGE RATINGS None Available

RAINFALL/RESERVOIR RECORDS Reservoir levels are constantly monitored by means of a telemetric device

ITEM	REMARKS
DESIGN REPORTS	None Available.
GEOLOGY REPORTS	None Available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None Available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY } FIELD }	None Available
POST-CONSTRUCTION SURVEYS OF DAM	None Available
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	A telemeter monitors the reservoir levels.
MODIFICATIONS	Figure 3 in Appendix E shows the section of the dam that was raised in 1942.
HIGH POOL RECORDS	The pool levels are constantly monitored.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None Available.
PRIOR ACCIDENTS OR FAILURE OF DAM REPORTS	None Recorded
MAINTENANCE OPERATION RECORDS	None Available.

ITEM	REMARKS
SPILLWAY PLAIN	
SECTIONS	Edgemoor Reservoir Dam has no spillway.
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	None Available.
MISCELLANEOUS	Figures 2 and 3 in Appendix E were the only information obtained from DNREC.

APPENDIX

B

Check List

Visual Inspection

Phase I

CHECK LIST
VISUAL INSPECTION
PHASE I

Sheet 1 of 3

Name Dam	<u>Edgemoor Reservoir Dam</u>	County	<u>New Castle</u>	State	<u>Delaware</u>	National	
Type of Dam	<u>Earth</u>	Hazard Category		<u>High</u>		ID #	<u>DE 00012</u>
Date(s) Inspection	<u>Sept. 20, 1979</u>	Weather	<u>Clear</u>	Temperature	<u>700 F</u>		

Pool Elevation at Time of Inspection 79.3 ± M.S.L. Tailwater at Time of Inspection N/A M.S.L.

Inspection Personnel:

Lee DeHeer	<u>Leonard Beck</u>	Robert Bowers	
		Robert Bowers	Recorder

Remarks:

Mr. Krishna Patel, Delaware DNREC, and Mr. Pete Sheats, Purification Superintendent for the Wilmington Suburban Water Co., were also present during the inspection.

EMBANKMENT

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The vertical alignment of the crest appeared to be good.	
RIPRAP FAILURES	The interior slope protection was damaged at one location during the installation of the telemeter and has not been repaired.	The crest and interior slope protection should be repaired.

VISUAL EXAMINATION OF		OBSERVATIONS	REMARKS OR RECOMMENDATIONS
<u>EMBANKMENT</u>			
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM		No problem observed	
ANY NOTICEABLE SEEPAGE		None observed	
STAFF GAGE AND RECORDER		None	
DRAINS		The 16-inch pipe through which all inflow and outflow occurs is located through the base of the embankment and could not be inspected.	

APPENDIX

C

Hydrologic & Hydraulic Data



OBRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
EDGEMOOR RESERVOIR DAM	1	DBC	10/29/79	

HYDROLOGY

THE DRAINAGE AREA TO THIS RESERVOIR IS EQUAL TO THE RESERVOIR SURFACE FOR THIS SITE. THEREFORE, THE DESIGN STORM (1/2 PMP) IS APPLIED DIRECTLY TO THE RESERVOIR.

FROM HMR #33, THE 24 HOUR, 200 SQUARE MILE PMP INDEX RAINFALL IS 24 INCHES.

THIS RAINFALL IS REDUCED BY THE HOP BROOK ADJUSTMENT FACTOR* OF .8 (< 10 SQ.MI.). THEREFORE, THE ADJUSTED INDEX RAINFALL IS 19.2 INCHES.

THE EXPECTED 48 HOUR PMP RAINFALL FOR A BASIN WITH LESS THAN 10 SQUARE MILES OF DRAINAGE AREA IS 1.32 TIMES THE INDEX RAINFALL (OR 25.3 INCHES).

THE DESIGN STORM IS 1/2 OF THE PMP, OR 13.65 INCHES. SINCE THE RESERVOIR IS PROVIDED WITH ONE FOOT OF FREEBOARD ABOVE THE NORMAL POOL SHOWN ON THE DRAWINGS, THE RESERVOIR CAN STORE 88% OF THE DESIGN STORM (44% OF THE PMP). THE RESERVOIR WOULD BE CAPABLE OF STORING THE ENTIRE DESIGN STORM IF THE OPERATING POOL IS MAINTAINED AT OR BELOW (83.3 - 13.65/12 = 82.16) ELEVATION 82.0.

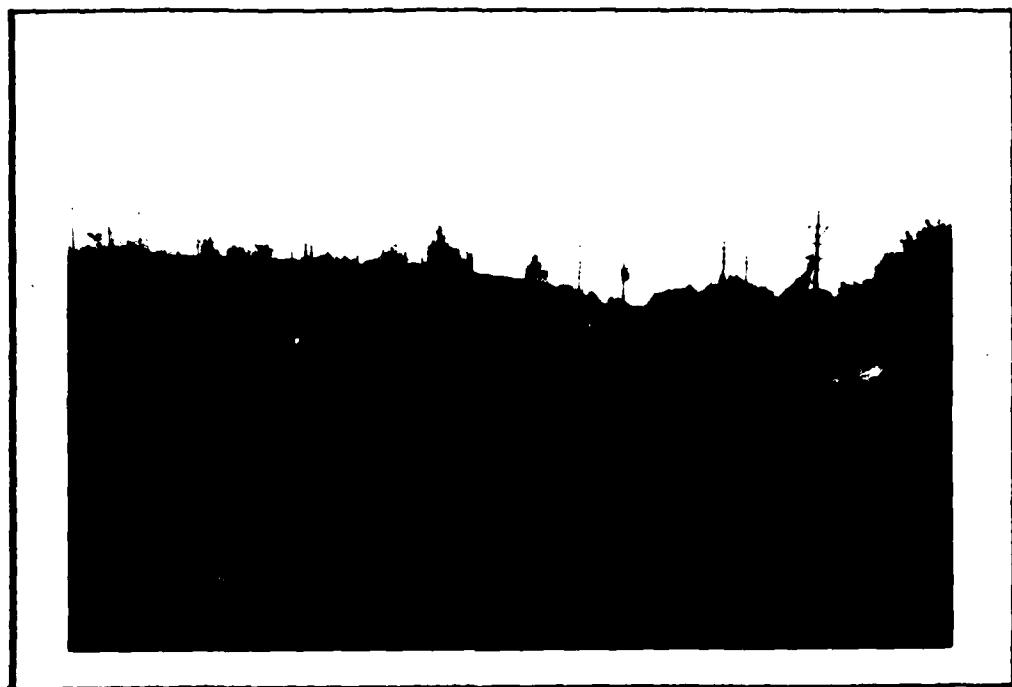
THE MAXIMUM POOL OF RECORD IS THE NORMAL POOL ELEVATION OF 82.3. IN THE FUTURE, THE OPERATING POOL SHOULD NOT EXCEED ELEVATION 82.0.

* THIS FACTOR ADJUSTS FOR THE PROBABLE MISALIGNMENT OF THE DRAINAGE BASIN AND STORM ISOHYETALS.

APPENDIX

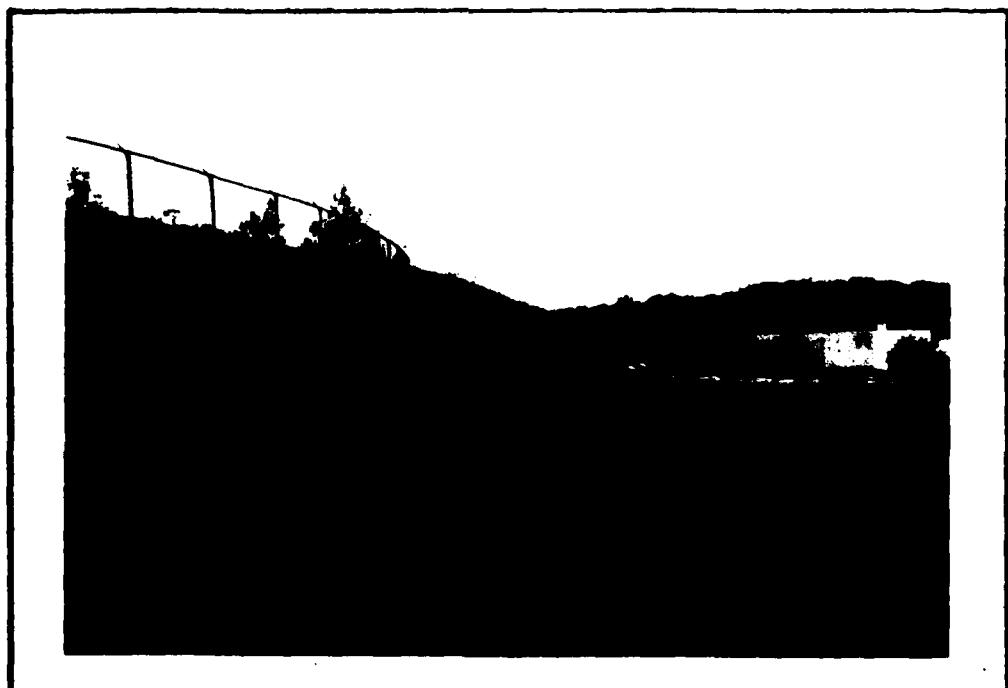
D

Photographs



EXTERIOR OF WESTERN PORTION
OF EMBANKMENT

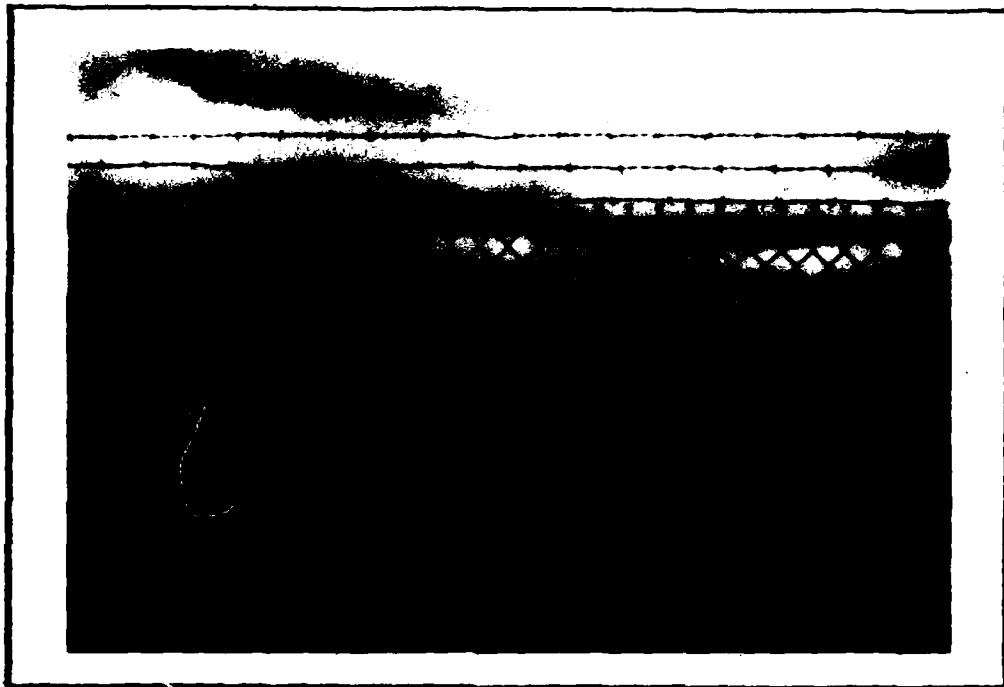
10-11-79



VIEW OF EXTERIOR OF EMBANKMENT
SHOWING RECENTLY CUT SLOPE

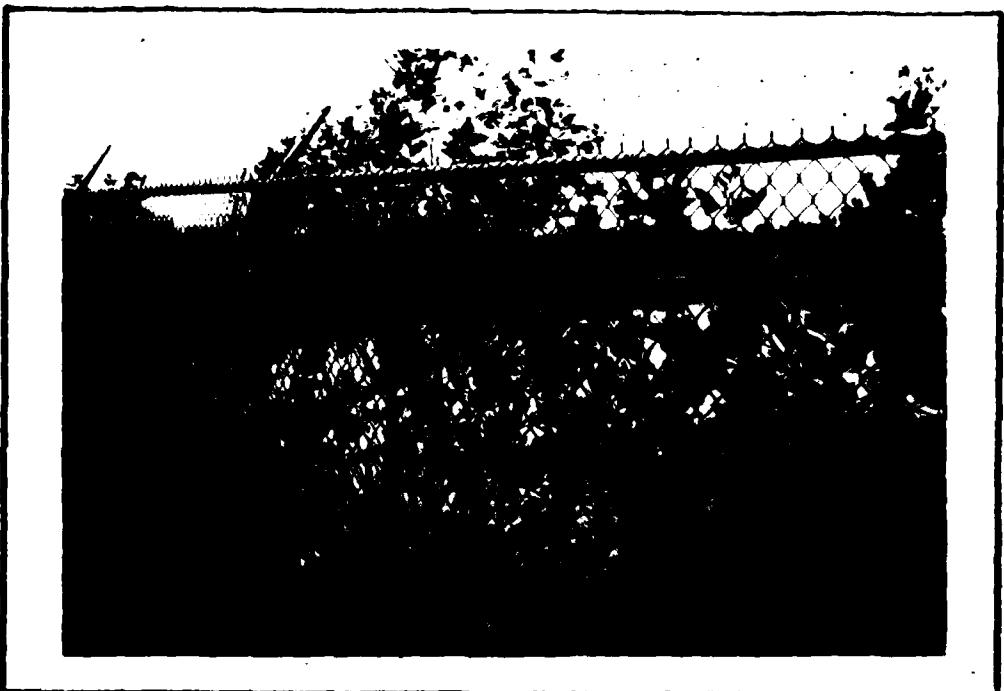
10-11-79

D-1



VIEW ACROSS RESERVOIR WITH PART OF
DAMAGE AREA IN BACKGROUND

10-11-79



TREES GROWING FROM INTERIOR SLOPE

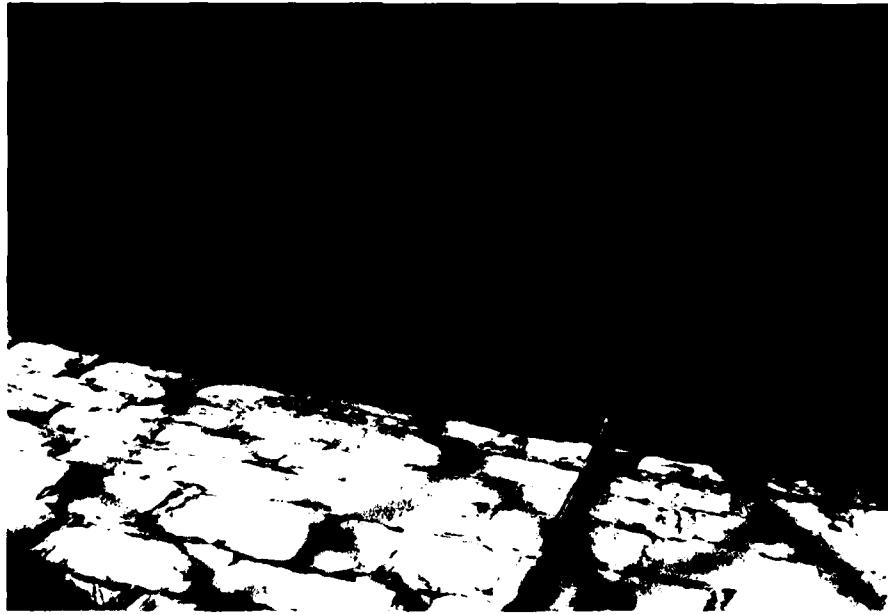
10-11-79

D-2



PORTION OF CREST AND
INTERIOR SLOPE DAMAGED BY
INSTALLATION OF TELEMETER

10-11-79



VIEW OF MASONRY CONDITION ON INTERIOR SLOPE
SHOWING STONES IN RESERVOIR FROM
TELEMETER INSTALLATION

10-11-79

D-3



VIEW OF BROKEN PIPE
LOCATED ALONG THE INTERIOR SLOPE
10-11-79



VIEW FROM SOUTHERN PORTION OF CREST
SHOWING THE CHLORINATOR HOUSE
10-11-79

D-4

APPENDIX

E

Drawings

TABLE OF CONTENTS

APPENDIX E

REGIONAL VICINITY MAP	FIGURE 1
PLAN VIEW AND SECTIONS	FIGURE 2
RAISED SECTION	FIGURE 3

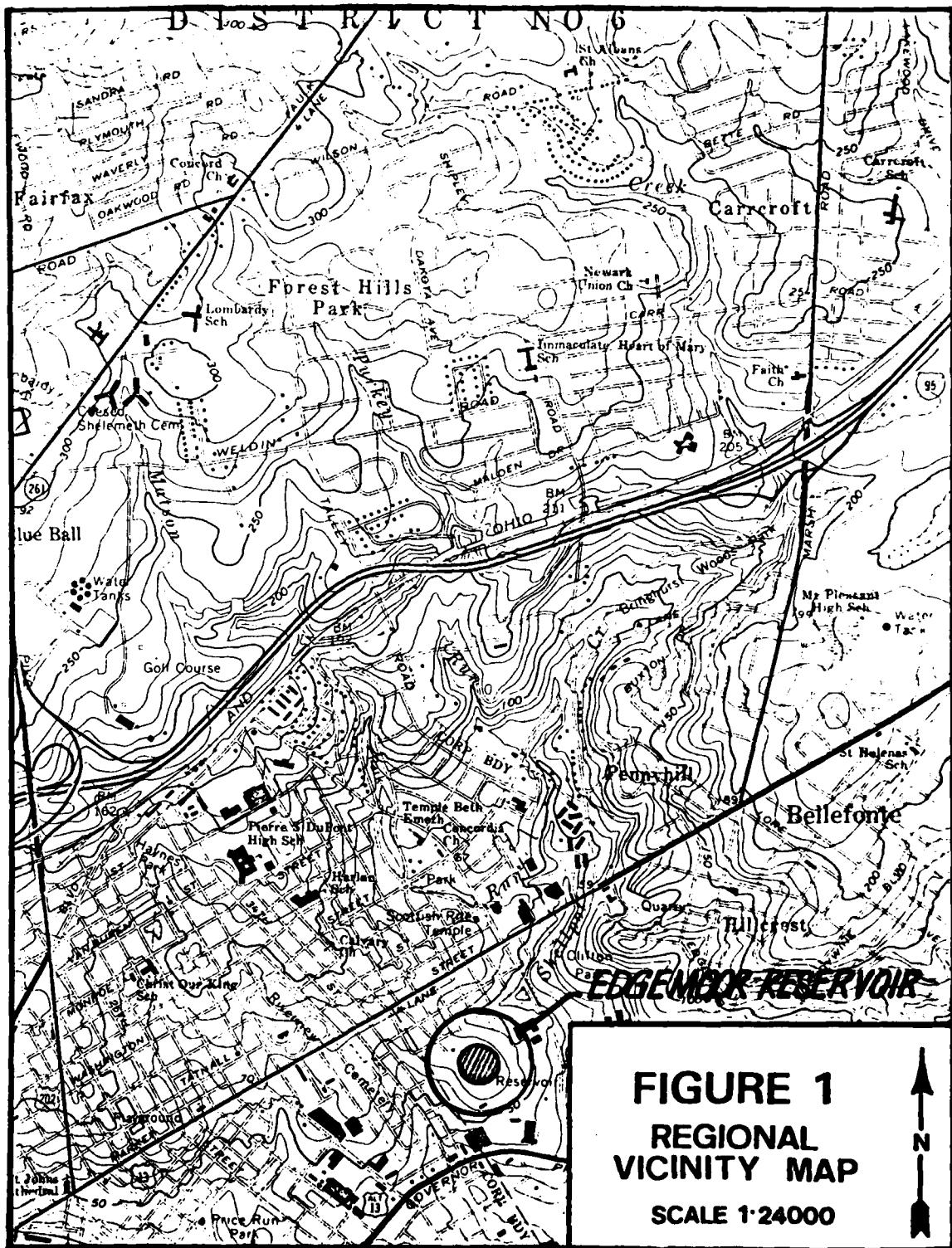
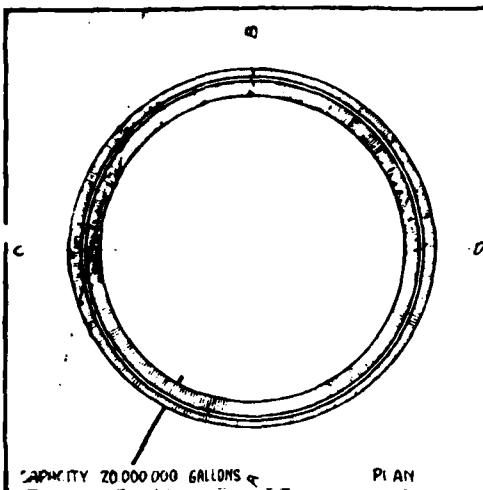


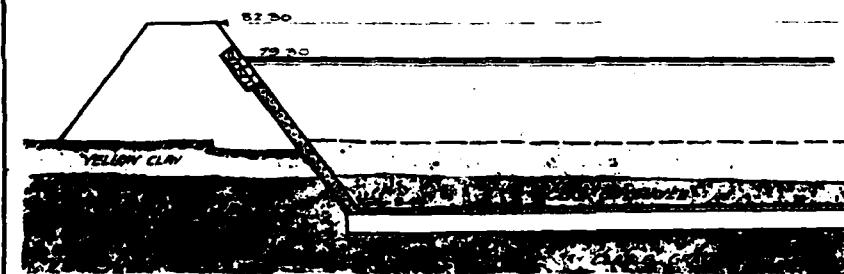
FIGURE 1 REGIONAL VICINITY MAP

SCALE 1:24000

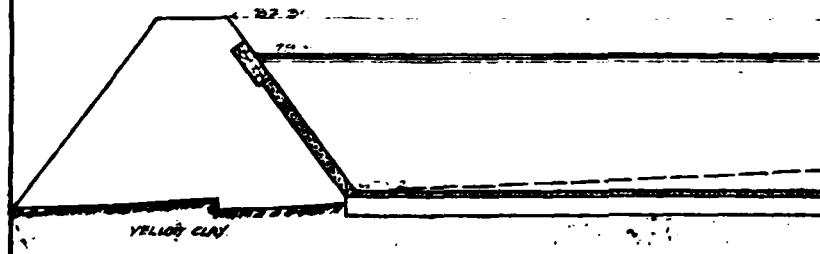


EDGE MOOR RESERVOIR.

SECTIONAL ELEVATION THRU
SCALE 1 IN. = 10 FEET



GEOLOGICAL SECTION THRU

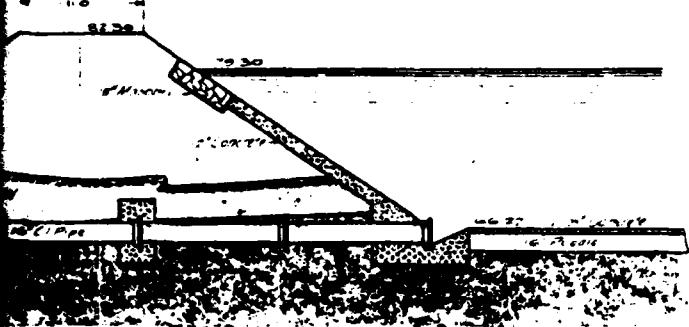


GEOLOGICAL SECTION THRU
SCALE HORIZONTAL 1 IN. = 10 FEET
VERTICAL 1 IN. = 10 FEET

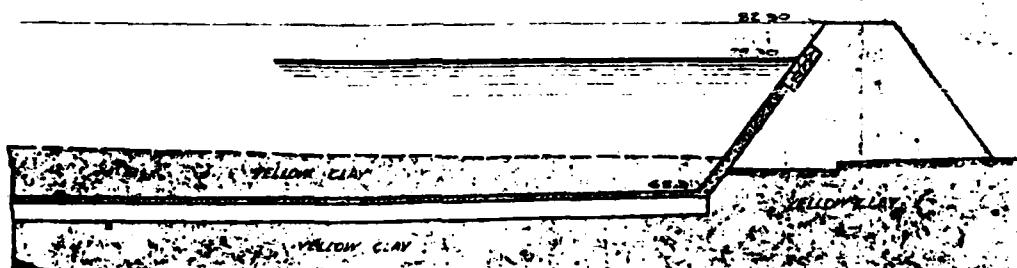
GEOLOGICAL SECTIONS OF RESERVOIRS
ALONG THE
PENNSYLVANIA RAILROAD

THE AMERICAN PIPE MFG. CO.
ENGINEERS & CONTRACTORS,
112 N. BROAD ST., PHILA., PA.

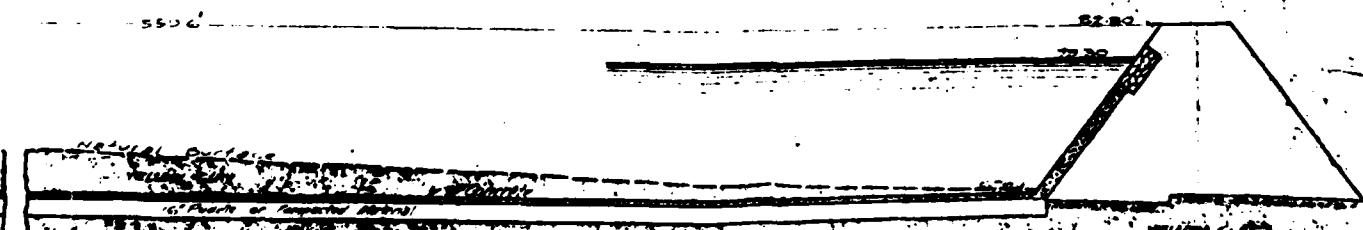
1905



ELEVATION THROUGH INLET PIPE
SCALE 1 IN.=10 FEET



SECTION THROUGH A-B



SECTION THROUGH C-D

HORIZONTAL 1 IN = 20 FT 2 10 20 30 40
VERTICAL 1 IN = 10 FT 2 10 15 20

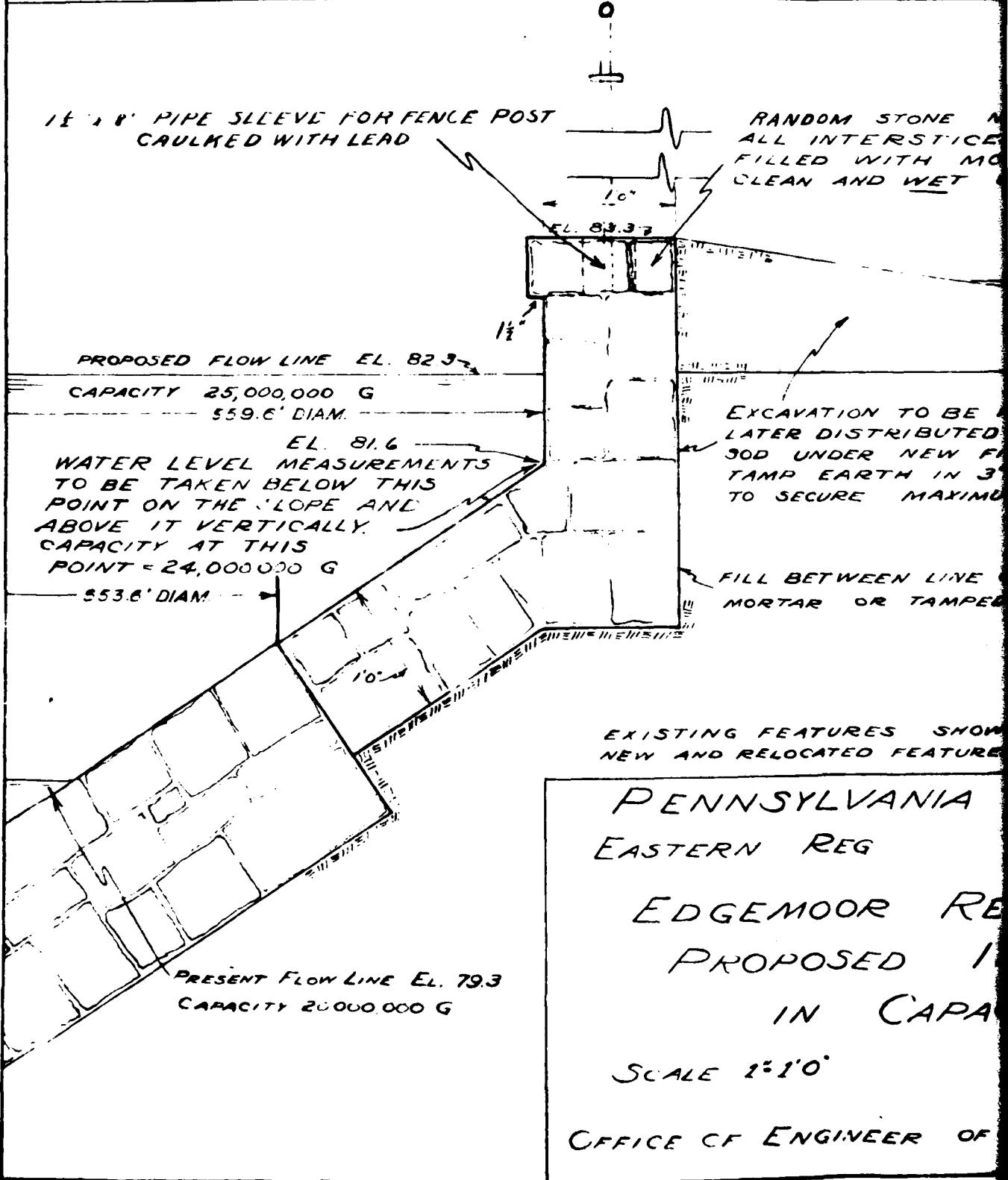
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FIGURE 2

2

GENERAL DIRECTIONS

1. DO NOT EXCAVATE FOR OVER 20' OF MASONRY AT A TIME
2. MASONRY TO BE COMPLETED FIRST, THEN MOVE FENCE
3. MORTAR TO BE BY VOLUME: 1 PART CEMENT : $2\frac{1}{2}$ PARTS CLEAN



INSTRUCTIONS:

ICE; THEN DISTRIBUTE EARTH
EAN RIVER MORTAR SAND: 1 PART HYDRATED LIME

MASONRY, STRUCK JOINTS
ICES TO BE COMPLETELY
MORTAR. STONES TO BE THOROUGHLY
T WHEN PLACED.

? APPROXIMATE SLOPE

BE PILED WHERE CONVENIENT AND
ITED AS SHOWN. REMOVE ALL
W FILL, ROUGHEN SURFACE AND
N 3" LAYERS, MOISTENING SUFFICIENTLY
MINUM COMPACTION

INE OF EXCAVATION AND STONE WITH
MPED EARTH.

SHOWN THUS —————
TURES SHOWN THUS —————

A RAILROAD
MARYLAND DIV.

RESERVOIR
INCREASE
PACITY

JUNE 6, 1942

OF WATER SERVICE

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FIGURE 3

Engraved 2-15-43. PME Revised 2-7-73, MD

APPENDIX

F

Site Geology

SITE GEOLOGY
EDGEMOOR RESERVOIR DAM

Edgemoor Reservoir Dam is located in the Lowlands Section of the Piedmont physiographic province. Bedrock at the site is the Paleozoic Wilmington Complex which is composed of banded gneiss and prominent amount of gabbro, amphibolite and granite.

These metamorphic and igneous rocks have differentially weathered in situ such that their character varies from a hard rock mass to a soil-like material.

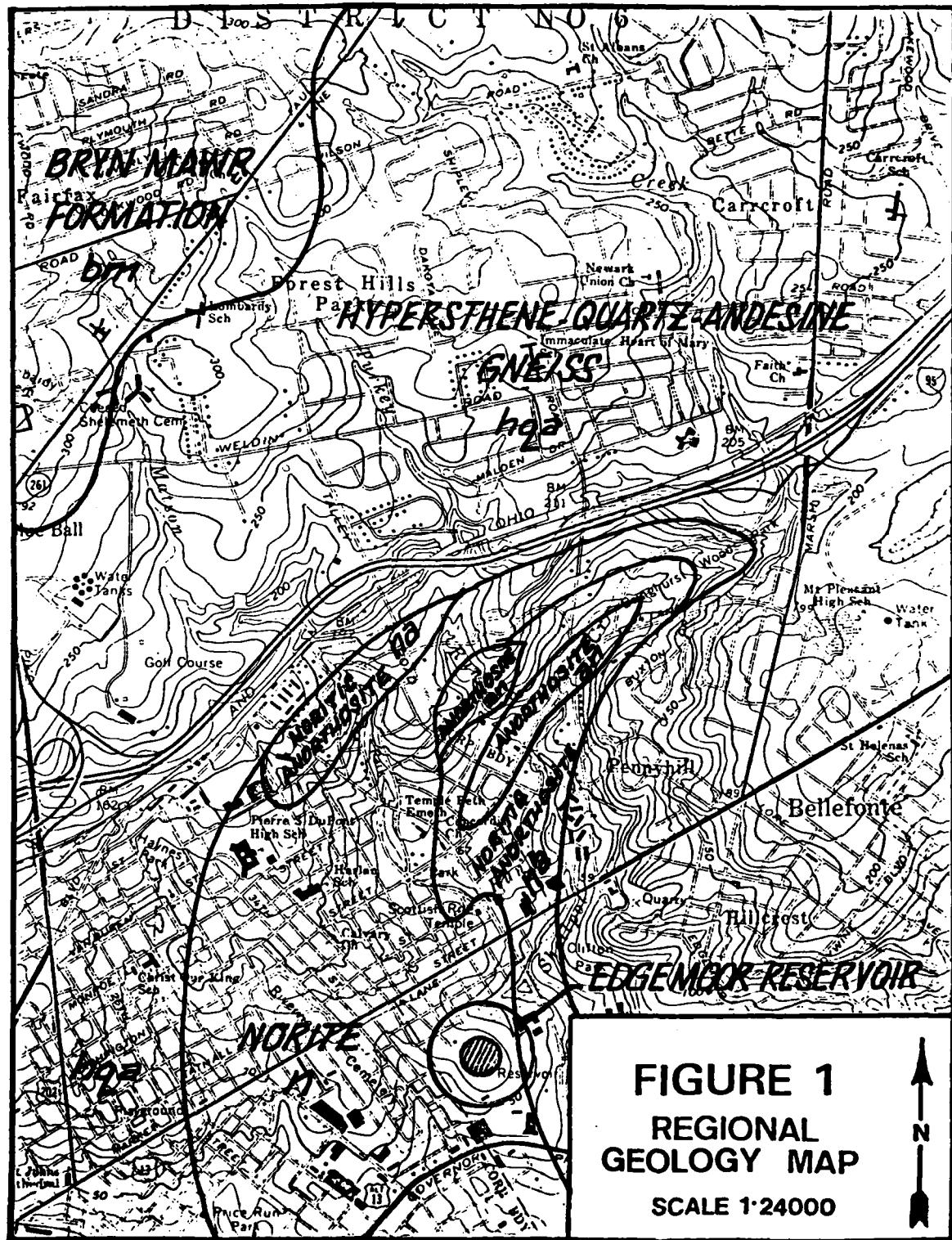


FIGURE 1
REGIONAL
GEOLOGY MAP

